METHOD AND DEVICE FOR PRODUCING NITRIDE SINGLE CRYSTAL

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Inventor: UEHARA KAZUHIRO; SASAKI TAKATOMO; MORI YUSUKE; YOSHIMURA MASASHI
Applicant: KOBE STEEL LTD;; SASAKI TAKATOMO;; MORI YUSUKE;; YOSHIMURA MASASHI
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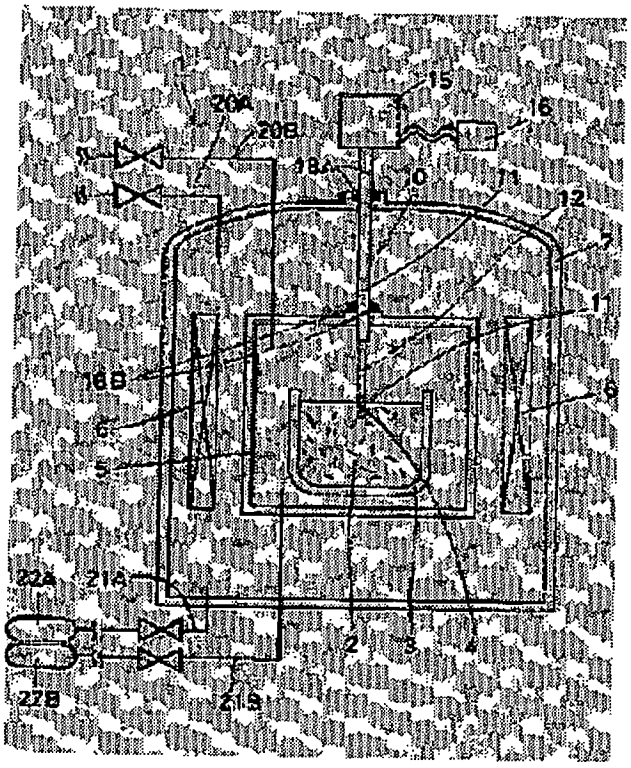
Abstract of **JP2002068896**

PROBLEM TO BE SOLVED: To provide a production method for obtaining a bulky nitride single crystal, in which it is possible to control the generation of a nucleus and by which the nitride single crystal having a high quality and a large size can be obtained at a relatively low temperature and low pressure. SOLUTION: A seed crystal is placed in a raw material for growing the nitride single crystal and then a crystal is grown by locally heating the seed crystal. Especially, it is preferable that crystal growth is carried out in such a manner that the seed crystal is locally heated while maintaining the temperature of the raw material for growing the nitride single crystal at a temperature at which the crystal hardly grows so that the temperature of the raw material present in the vicinity of the seed crystal is maintained at a high temperature at which the crystal can grow.



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Applicant: KOBE STEEL LTD

Applicant: Takatomo SAKAKI

Applicant: Yusuke MORI

Applicant: Masashi YOSHIMURA

Inventor: Kazuhiro UEHARA

Inventor: Takatomo SASAKI

Inventor: Yusuke MORI

Inventor: Masashi YOSHIMURA

[Claims]

[Claim 1] A method for producing a nitride single crystal comprising:

placing a seed crystal in a raw material for growing the nitride single crystal; and

locally heating the seed crystal to grow a crystal.

[Claim 2] The method for producing the nitride single crystal according to claim 1, wherein crystal growth is carried out in such a manner that the seed crystal is locally heated while maintaining the temperature of the raw material for growing the nitride single crystal at a temperature at which the crystal hardly grows so that the temperature of the raw material present in the vicinity of the seed crystal is maintained at a high temperature at which the crystal can grow.

[Claim 3] The method for producing the nitride single crystal according to claim 1 or 2, wherein the crystal growth is carried out in such a manner that the local heating temperature to the seed crystal is controlled while measuring a temperature in the vicinity of the seed crystal.

[Claim 4] A device for producing a nitride single crystal comprising:

a raw material storage vessel for storing a raw material for growing the nitride single crystal;

a pressure vessel capable of storing the material storage vessel; and

a heater for heating the raw material for growing the nitride single crystal,

the pressure vessel having a placing part for placing the seed crystal in the raw material for growing the crystal, and the placing part having a heating means for heating the seed crystal.

[Claim 5] The device for producing the nitride single crystal according to claim 4, wherein the placing part is movably constituted so that the position of the seed crystal in the pressure vessel can be changed.

[Claim 6] The device for producing the nitride single crystal according to claim 4, wherein the heating means is composed by a heater capable of placing the seed crystal; and the heater is provided at a tip of a placing shaft extended from a moving device provided at the outside of the pressure vessel, whereby the position of the seed crystal in the pressure vessel can be movably changed by driving the placing shaft by the moving device.

[Claim 7] The device for producing the nitride single crystal according to any of claims 4 to 6, further comprising a measuring part for

measuring the temperature of the raw material for growing present in the vicinity of the seed crystal, and a controller for controlling the temperature of the heating means according to the measured temperature.

[Claim 8] The device for producing the nitride single crystal according to any of claims 4 to 7, wherein the raw material storage vessel is supported by a support having a vertically movable shaft for freely moving up and down the storage vessel.

[0002]

[Prior Art] Recent years, attentions have been focused on, for example, gallium nitride light emitting diodes and laser diodes as high-intensity blue ultraviolet emission devices. These devices have been conventionally produced by forming gallium nitride crystal thin films using epitaxial growth on sapphire substrates. In the gallium nitride as the thin film, the lattice constant difference (13.8 %), thermal expansion coefficient difference (25.5 %) and difference of cleavage surfaces between a substrate and a thin film become problems. There are problems in that it is difficult to obtain sufficient crystallinity since consistency between the substrate and the thin film is poor.

[0025] A support 34 for supporting the crucible 3 is provided in the inner vessel 5, and the support 34 is provided with a vertically movable shaft 35 for moving up and down the crucible 3. The crucible 3 can be freely moved up and down by a vertically movable device (not shown) with the aid of the vertically movable shaft 35, and can give suitable temperature

distribution to the raw material 2 for growing the crystal in the crucible 3. The vertically movable shaft 35 also has a rotation function, can rotate the crucible 3 to equalize the temperature distribution in the horizontal direction of the raw material 2 for growing the crystal, and can control the growth interface shape of the crystal being grown.

[0032] The present inventors considers that the quality of the above example is not significant different from that of comparative example referring to the micro quality as the crystal. However, the beautiful crystal obtained in the example had a sufficient size and a uniform size. These results show that the growth speed of the seed crystal is easily controlled by maintaining the raw material for growing the crystal at a low temperature than that of the seed crystal at a low temperature at which the crystal growth is hardly viewed, and maintaining only the seed crystal at a high temperature at which the crystal can be grown, and the bulky nitride single crystal having a high quality can be obtained.

[0033] Since the raw material for growing the crystal is maintained at a relatively low temperature, a window or the like for observing the crystal grow is easily set, and it is also preferable in an equipment control. In addition, potassium or the like can be also used as the flux. As a nitrogen source, nitride gas and nitride-containing gas or the like can be used in addition to the nitrogen gas described above. Further, the method and device for producing the single crystal described above are also suitable for producing the other nitride single crystals such as AlN. The pressure at the time of growing the crystal is preferably 50 atmospheres or more, and the

crystal is grown while holding the pressure to a fixed value. It is preferable that the temperature at which the crystal can be grown is 700 °C or more.

[0034] Although the placing shaft is provided so as to penetrate from the upper part of the pressure vessel in above description, the placing shaft may be provided so as to penetrate from the lower part or the like of the pressure vessel. The construction of the placing part is not limited to above construction, and a construction capable of placing the seed crystal in the raw material for growing the crystal and of heating the seed crystal can be adopted.

[0035]

[Effect of the Invention] Since the seed crystal placed in the raw material for growing the crystal is locally heated and the crystal is grown from only the crystal material present in the vicinity of the seed crystal in the present invention, the position and crystal growth speed of the crystal growth in the raw material for growing the crystal can be easily controlled, and the bulk nitride single crystal having a high quality and a large size can be obtained.